BUREAU OF ENVIRONMENT

CONFERENCE REPORT

DATE OF CONFERENCES: May 4 and 11, 2006

LOCATION OF CONFERENCES: J.O. Morton Building

ATTENDED BY: Marc Laurin, Christine Perron, Jon Evans, Kevin Nyhan, Mark Hemmerlein, Charles Hood, Bill Hauser, Dennis Danna, Phil Miles, Bob Juliano, Nancy Mayville, Dave Powelson, and Tim Boody, NHDOT; Jim Garvin, Linda Wilson, Emily Paulus, and Edna Feighner, NHDHR; Harry Kinter and Ed Woolford, FHWA; Lynne Monroe and Carol Hooper, Preservation Co.; Mike Johnson, Maine Historical Commission (via phone); Addie Kim and John Watters, HNTB; Richard Candee, Portsmouth Historical Society; Evan Detrick, Dubois and King; and Bill Gegas, DRED.

***SUBJECT**: Monthly SHPO-FHWA-ACOE-NHDOT Cultural Resources Meeting*

Thursday, May 4, 2006

Portsmouth, BHF-X-T-0101(015), 13678. Participants: Participants: Kevin Nyhan (1553) and Nancy Mayville; Addie Kim and John Watters, HNTB; Mike Johnson, Maine Historic Commission (207-287-2992 / mike.d.Johnson@maine.gov); and Richard Candee, Consulting Party, Portsmouth Historical Society.

Direct Questions and Responses (J. Garvin):

1) J. Garvin requested a copy of the bridge inspection report, noting that NHDHR has a copy of the "Preliminary Structures Report" of February 3, 2004. *Note that a copy of the October 2003 Structural Inspection Report and May 18, 2004 (FINAL) Preliminary Structures Report were forwarded to James Garvin on April 27, 2006 and to Richard Candee on May 10, 2006.*

2) J. Garvin requested a graphic representation of the members with a condition rating of 5 or less that would be replaced under Alternative 2 (Lift Span Rehabilitation). He assumed that those not coded for replacement would be cleaned and retained in service. He also assumed that virtually the entire floor system (beams and stringers) of the lift span will be slated for replacement.

> *In general the attached cross section and elevation graphics of the bridge show the members of the lift span with a condition rating of 5 or less.*
>
> *All the longitudinal stringers and transverse floor beams under the roadway of the lift span are rated 5 or below and require replacement. The longitudinal sidewalk stringers are also rated 5 or below and will require replacement.*
>
> *The cantilever sidewalk brackets are in poor condition, but HNTB is proposing to repair them. Repair will most likely include isolate, addition of steel plates to areas that have holes, and addition of steel plates to the top of the bracket to account for top flange deterioration.*
>
> *The truss chords are rated 5, but replacement is not feasible (particularly at the panel point connections). The condition of the lift span truss lower chord is of particular concern because of the years of exposure under an open steel grid deck. HNTB proposes to paint and repair the chords where possible.*
>
> *The truss diagonals and verticals exhibit deterioration at the panel point locations and again replacement is not feasible. Painting and repair is proposed for these members.*

The following table summarizes the percentage and type of work anticipated for each major bridge element on the Lift Span under the Rehabilitation Option. The percent was computed using liner foot of steel member.

Rehabilitation Option: Lift Span work as percent of total liner foot of steel

Element	*Repair*	*Replace*	*Clean/Paint*
Roadway Framing	*0*	*100*	*0*
Sidewalk Framing	*25*	*65*	*10*
Truss Chords	*40*	*0*	*60*
Truss Diag/Verticals	*80*	*0*	*20*
Truss Panel Points	*40*	*0*	*60*
Total Lift Span	*30*	*55*	*15*

3) the same for the flanking spans;

In general the attached cross section graphic of the bridge shows the members of the flanking spans with a condition rating of 5 or less.

All the longitudinal roadway stringers under the curb lines (S3 and S7) will require replacement. We also anticipate that all the longitudinal sidewalk stringers will require replacement.

The transverse floor beams located at the joint between the fixed truss spans and the lift span are heavily deteriorated and will likely require replacement. The remaining transverse floor beams exhibit deterioration at the connection to the lower truss chord, but are in satisfactory condition otherwise. Thus, rehabilitation is proposed for those members.

The cantilever sidewalk brackets are in poor condition, but we are proposing to repair them. Repair will most likely include isolated addition of steel plates to areas that have holes, and addition of steel plates to the top of the bracket to account for top flange deterioration.

Similar to the lift span, the truss chords are rated 5, but replacement is not feasible (particularly at the panel point connections). We proposed to paint and repair the chords where possible. The truss diagonals and verticals exhibit similar deterioration at the panel point locations and again replacement is not feasible. Painting and repair are proposed for these members

The following table summarizes the percentage and type of work anticipated for each major bridge element on the Approach Trusses and Kittery Spans under the Rehabilitation Option. The percent was computed using liner foot of steel member.

Rehabilitation Option: Approach Trusses and Kittery Spans work as percent of total liner foot of steel

Element	*Repair*	*Replace*	*Clean/Paint*
Roadway Framing	*40*	*40*	*20*
Sidewalk Framing	*25*	*65*	*10*
Truss Chords	*50*	*0*	*50*
Truss Diag/Verticals	*80*	*0*	*20*
Truss Panel Points	*20*	*0*	*80*
Total Approach Spans	*40*	*35*	*25*

4) J. Garvin requested a statement of the methods by which deteriorated portions of members would be repaired at panel points (i.e., how would the feet of posts and diagonals be spliced in order to secure proper connections at gusset plates, especially at the lower panel points?)

The methods to repair the deteriorated panel points are illustrated in the photographs below. The procedure would be similar to what was accomplished during the emergency repairs in 2004. A basic step outline is:

A. The existing rivets are removed by drilling and a high strength bolt is installed in the old rivet hole. (Only a few rivets are removed at a time to maintain integrity of the connection)
B. New holes are drilled and new bolts installed as necessary for the loads on the connection.
C. A template is used to fabricate a "cheese plate" over the newly installed bolts and nuts.
D. A final "new" gusset plate is installed over the "cheese plate" and connected to the high strength bolts with a second nut.

The result of this repair is that deterioration on the bridge diagonals is now hidden behind the newly installed gusset plates. The surfaces were cleaned of rust and painted, however it is not possible to remove all the chlorides that have infiltrated the steel members.

This repair method was chosen as the only repair that could be accomplished while still maintaining the structural integrity of the bridge. Removal of the existing gusset plates would have created instability and failure of the truss.

The base of the diagonals and verticals would be repaired in a similar manner where additional steel angles would be bolted to existing steel members for improved strength. A procedure to methodically replace rivets with high strength bolts would be similar to the gusset plate repair.

5) J. Garvin requested statement of any difference in expected service life between a rehabilitated lift span with solid deck and the rehabilitated flanking spans, with an explanation (if there is a difference in expected service life) of how an equal service life might be attained for the rehabilitated lift span and the rehabilitated flanking spans;

The expected service life of each span is directly related to the quality of the painting system that protects the steel from deterioration, and the condition of the base steel that accepts that painting system.

A rehabilitated lift span with a solid deck would have a comparable expected service life to the rehabilitated flanking spans. In this situation, repairs would be completed where appropriate, however the three spans would generally maintain the existing truss members with built up members and chloride infiltrated steel. Thus, the painting system would be expected to last the same period of time.

The primary difference in service life would be the condition of the existing lower truss chord. The lower truss chord on the lift span has been exposed to more deterioration because of the existing open grid deck. As such, the lower truss chord on the lift span is more sensitive to additional deterioration and section loss. If a paint system fails, the lower chord could deteriorate and become more critical quicker than on the approach trusses.

If a new lift span were installed, the truss members would not be comprised of built up members and would be free of chloride infiltrations. Thus the painting system would last longer and provide a longer protection to the steel members. As a result, the new lift span would have a longer expected service lift than the adjacent rehabilitated spans.

6) J. Garvin requested a statement and/or graphic representation of the methods to be used in strengthening the lift towers to accommodate the added weight of the half-filled deck;

Detailed calculations and drawings have not been developed since the project is early in design development. However, the strengthening may involve the addition of steel plates or steel members to the primary tower legs and cross bracing. The new steel would most likely be bolted to the existing members since welding would be extremely difficult up on the towers. The strengthening would mostly be accomplished above the upper truss chord and painted. Since these locations are between 35 to 150 feet above the roadway surface, their visual impact would be minimal.

7) J. Garvin requested a comparison of the differences (if any) between tower strengthening required for a rehabilitated lift span versus a replaced lift span;

> *The tower strengthening for a rehabilitated lift span or a replaced lift span would be very similar. The primary reason for strengthening would be the increased weight of the new solid roadway surface. Detailed calculations have not been performed to compare exact final weights of each alternative, but it is currently anticipated that they would be similar in weight. It is possible that the replaced lift span option would be slightly lighter due to the reduced amount of bracing and utilization of higher strength steels (with lighter weights) for the primary truss members. The rehabilitated span weight may also be heavier due to the presence of existing steel repair plates and the addition of new steel repair plates added to the old steel structure.*

8) J. Garvin requested a statement of why droop cables need to be substituted for the original (and extant) trolley system for electrical supply to the motors.

> *The existing trolley system used for electrical supply is shown in the attached photograph. It is a system where wheels ride up and down a wire and the electricity is transferred through contact as the bridge moves up and down. The desire to replace the trolley system is based on safety and maintenance as well as reliability.*
>
> <u>*Safety*</u>*: The exposed wheels and wires are an electrical hazard to workers. Since the system relies on contact, there is no shielding on the wires and electrocution would result from accidental contact. This a particular concern in the winter when ice forms on the wires and the bridge personnel must go out to the wires to activate a de-icing system in poor weather conditions. The droop cables are shielded and thus protected from accidental electrocution and formation of ice on the wires.*
>
> <u>*Maintenance*</u>*: The trolley wheels are replaced on roughly a yearly basis to continue reliable operation. Additionally, the "scissor"-mounting mounting element that maintains tension on the wheels for contact, is replaced every few years.*
>
> <u>*Dual Function and Reliability*</u>*: While the existing trolley wheel system can work for power transfer, it is not feasible to use this system for control signal transfer. With the Control House moved off to the approach span, we need to wire control signals (as well as power) back to the movable span. The droop cables will provide the control wiring and power. The existing system uses radio signals for gate control. Radio or other wireless communication could be used to eliminate some of the control signals but it is still desirable to keep some backup and safety signals "hard wired" through the droop cable. Additionally, the bridge operators have cited failure and complications with the current wireless communication systems on the bridge (gates and Closed Circuit TV). Droop cables would be more reliable.*

<u>**Direct Questions and Responses from Professor Emeritus Richard M. Candee, Consulting Party, Vice President, Portsmouth Historical Society**</u>

1) I think I understood someone to say that the repairs done by NHDOT in the 1980s actually are a reason to prefer replacement, as rusted ends of the Warren truss chords are now sandwiched between new steel.

I object intellectually to opting for replacement under 4(f) and 106 based on any combination of deferred maintenance and lack of foresight by DOT. If not foreseen, some comment of the experiments done in those repairs might be in order. Were there reports of what was learned?

> *HNTB is not aware of any formal reports based on the performance of the 1980's repair work. The October 2003 inspection reports on some of those specific locations and the current condition of those repairs can generate some immediate comments:*
>
> 1) *The 1980's repairs completed under the open grid deck and are showing signs of advanced deterioration.*

2) *Lateral gusset plates and other steel details that collect water and are showing signs of significant section loss.*
3) *The painting system applied in the 1980's has failed throughout the entire structure.*
4) *It is not possible to inspect the condition of deteriorated steel members that have been sandwiched between 1980's installed plates.*
5) *Additional miscellaneous repairs have been accomplished since the 1980's by bridge maintenance with similar deterioration performance issues.*
6) *Details that allow water (rain water and salt laden snow melt) to collect on flat surfaces perform very poorly even with a new painting coating system.*

2) This issue of apples and oranges remains. Are we comparing an equally strong and long-lasting bridge with both rehab and replacement? If not, in what ways specifically do they vary?

A new lift span would be "stronger and longer lasting" than a rehabilitated span. This is based on the use of current higher strength steels (50,000 psi vs. 33,000 psi strength) and less water sensitive details. Also the new lift span would have a shop applied painting system to new steel that is not infiltrated with chlorides.

On the rehabilitated spans, the new paint system would be field applied over existing steel that has inherent chloride infiltration from years of exposure to the salt environment. Chlorides work to deteriorate steel and cause paint systems to fail, and eventually lead to further steel deterioration. The new lift span would have a painting system that is applied over new steel that is not contaminated with chlorides and thus last longer to protect the steel and resist deterioration.

Please note that each design will be "strong" enough to handle the anticipated traffic loadings. Strength of the entire bridge is a very generic term that should be used with caution. A bridge made with older "weaker" steel can be equally as strong as a bridge with newer "stronger" steel. In generic terms this would mean that the older bridge would require more steel layers to make up for the lack of strength compare to the lighter stronger new bridge.

However, the inherent defects in the existing steel cannot be remedied by just adding new steel. New steel will increase the strength, but not prevent future deterioration of the existing steel. This could lead to structural instability as discussed in Comment 6 below and in the Additional Points of Discussion at the end of this memo.

3) Is there a complete survey of which pieces need replacement -- and why -- for the whole bridge? What are the standards used in making such determinations? (I know the needed answer for building, but am not sure for bridges.)

The October 2003 Inspection Report and the December 2003 Bridge Rating report document the bridge members that are deteriorated. These reports were used to estimate the total amount and cost of repair/replacement required for the whole bridge.

The October 2003 Inspection Report outlines the general condition of the bridge and tabulates many deteriorated members. The December 2003 Bridge Rating report uses information from the October 2003 Inspection Report to determine the existing bridge member capacity.

As a result of the Bridge Rating, if a member is calculated to be below the required capacity, it requires repair or replacement. Repair or replacement would be determined based on the cost and feasibility of each option. The standards used to determine a required capacity are based on industry guidelines that define the strength requirements for a bridge based on anticipated vehicle use.

The following tables summarize the percentage and type of work anticipated for each major bridge element on the Lift Span, as well as the Approach Spans under the Rehabilitation Option. The percent was computed using liner foot of steel member.

Rehabilitation Option: Lift Span work as percent of total liner feet of steel

Element	*Repair*	*Replace*	*Clean/Paint*
Roadway Framing	*0*	*100*	*0*
Sidewalk Framing	*25*	*65*	*10*
Truss Chords	*40*	*0*	*60*
Truss Diag/Verticals	*80*	*0*	*20*
Truss Panel Points	*40*	*0*	*60*
Total Lift Span	*30*	*55*	*15*

Rehabilitation Option: Approach Trusses and Kittery Spans work as percent of total liner feet of steel

Element	*Repair*	*Replace*	*Clean/Paint*
Roadway Framing	*40*	*40*	*20*
Sidewalk Framing	*25*	*65*	*10*
Truss Chords	*50*	*0*	*50*
Truss Diag/Verticals	*80*	*0*	*20*
Truss Panel Points	*20*	*0*	*80*
Total Lift Span	*40*	*35*	*25*

If the worst part of the lift span is just the open deck and below:

4) Has any study been done on fabricating a new deck and joining it to the historic fabric above. While I can conceive of substantial technical issues, including floating such a hybrid into place, it seems one possibility in need of some careful stated analysis.

Yes, this concept was studied. If the existing lift span truss is retained, fabrication of a new deck system off site and floating into place is not feasible. The issues are:

1) *If the entire existing roadway were removed to allow for a new deck system for the existing lift span to be floated into place, then no members would span from the upstream side of the truss to the downstream side of the truss for a 300-foot length. This would create an unstable bridge structure that may collapse.*

   Temporary bracing schemes were investigated to maintain stability of the truss during a complete deck removal and determined to be impractical since the contractor would not be able to work around the required temporary bracing.

2) *Another issue is the tolerance required for the connections of a new deck system to the old truss. The ability to align all the structural steel members with the existing framing would be virtually impossible. Even the use of slotted holes and oversized washers would not be sufficient to overcome the construction tolerance issues.*

3) *The proposed method to remove and install the lift span roadway framing is to remove at most a 60-foot section of roadway (i.e. two of the 30-foot bays) at a time so that the truss remains stable under construction.*

4) *J. Watters further clarified his statement with the following: This concept was to keep the existing lift span in place in the middle of the river, and float out a new roadway deck to the middle of the river, then join the new roadway deck to the existing lift span that is still in the middle of the river.*

The instability is associated with the LIFT SPAN only. If you take away the roadway deck, then there are not structural steel members that span from the ocean side of the lift span to the inland side of the lift span. Thus the LIFT SPAN truss is unstable. This instability has nothing to do with the flanking spans, and the flanking spans are not mentioned in the response.

I think the confusion may be that Dr. Candee's idea evolved into the "merged" concept that we have included in our matrix as a primary alternative.

5) Is there any evidence the lacey supports in the upper sections of the lift span are any less worthy (or more in need of repair) than those on the spans on either side that are planned for rehabilitation. If so, where and why?

> *No, there is no evidence of a difference in the extent of deterioration. The lacey supports on the upper section of the lift span and approach trusses are both in similar condition.*

6) If not, what is gained by moving to an entirely different structural system, with its attendant impact on the visual qualities of the lift span?

> *The benefits of a new lift span are based on long-term costs, constructability, structural stability, and durability. The proposed structural system is not entirely different. Rather the proposed structural system is still a Warren Truss with identical vertical and diagonal spacing configurations and similar general appearance of the truss.*
>
> <u>*Costs*</u>*: Long-term maintenance costs were considered as part of a life cycle cost analysis presented at the end of this memo. Long-term maintenance costs over 54 years would be $ 23 million greater with the rehabilitation option when considering painting, and could grow significantly more if the painting system is not maintained and interim structural steel repairs are required.*
>
> <u>*Constructability*</u>*: Replacement using the float-in, float-out method offers additional advantages of allowing construction to be expedited, possibly reducing construction time from 5 months to 4 months. Depending on the structural condition of the bridge, the rehabilitation option could extend beyond 5 months. This is due to the unforeseen complications that occur during a rehabilitation project. If additional parts are discovered to be needed, this situation could require substantial lead-time for fabrication and delay the construction, with the associated construction cost increase.*
>
> <u>*Structural Stability*</u>*: The existing deterioration at the panel points extends beyond the gusset plates into the diagonal members that are connected at those locations. Since they cannot be inspected, future deterioration could go undetected until such time that member deterioration becomes critical and compromises the trusses structural integrity. Should a diagonal or vertical member fail due to deterioration, the truss would become unstable, partially collapse, and become impassible to traffic. Operation of the lift span would also cease until the span could be moved to allow for navigational traffic.*
>
> <u>*Durability*</u>*: With the rehabilitation, repairs or painting would be required within 10 to 15 years for the lift span. With a new lift span, no maintenance will be required for 15 to 20 years. Rehabilitation, repairs, and painting of the existing lift span would result in more roadway disruption with the corresponding inconvenience to motorists, pedestrians, cyclists, emergency responders, and navigation.*

7) If so, and the issue remains the greater deterioration of the lift span, then has a total replacement of the lift section retaining (or replicating "in-kind") the riveted lacey structural system (above the deck at least) been considered and cost estimated? As the deck will be solid, and the below-deck structure seen only when raised, I suspect most preservationists would accept substantial modifications there as prudent and feasible -- although we agreed not to talk mitigation yet.

> *A replacement "in kind" was investigated during the preliminary structures report phase in early 2004. Based on the obvious cost premium and desire for a more cost effective long-term bridge structure, this concept was set-aside in favor of the more economical new lift span.*
>
> *A full cost estimate was not prepared for the replacement "in kind" since it was evident that a replacement with build up members would be substantially more expensive.*

However, for a comparison, consider an individual vertical truss member

- *Modern structural steel costs are comprised of 25% material and 75% labor*
- *Labor for bolted built up members would be up to 10 times greater than a solid member that does not require drilling, bolting, and assembly*
- *Assume a modern W14x109 is comparable in member size to the current built up vertical of 6x3 ½ inch angles with lacing members*

Fabrication Comparison: Built up member compared to solid rolled shape

Member	*Weight per foot*	*Material Cost*	*Labor Cost*	*Total Cost per foot*
Solid Vertical	*109 lbs / ft*	*0.25 / pound*	*0.75 / pound*	*$ 109*
Built up Vertical	*50 lbs / ft*	*0.25 / pound*	*7.75 / pound*	*$ 400*

Based on this brief comparison, it can be seen that a built up member would be approximately 4 times as expensive as a solid member. Expanding this cost premium to the entire lift span, the additional cost to the project for a replacement "in kind" could be $6 million.

Structural modifications below the deck are necessary regardless of how the project moves forward. The general configuration will be similar to the existing lift and approach spans with transverse floor beams and longitudinal stringers. The primary difference will be a solid deck on the lift span and the reduction from 7 to 5 longitudinal girders.

8) Could not a replacement-in-(visual)-kind -- allowing modern steel strengths, initial paint application, and building off-site and floating in (pretty much as described) -- be studied and considered before that of the 'preferred option' using new rolled I-beams? What is technically imprudent about such an alternative?

As noted in (7) above, a replacement "in kind" was investigated during the preliminary structures report phase in early 2004. Based on the obvious cost premium and desire for a more cost effective long-term bridge structure, this concept was set-aside in favor of the more economical new lift span. Also as noted in (7) above, the additional cost premium for the replacement in kind could be $6 million.

The technically imprudent issues are related to maintenance and long-term costs. In general, the more exposed steel members that can collect salt laden rainwater and snow melt, the more deterioration and maintenance that will be required. Therefore, more maintenance translates into more long-term costs.

The investigation of floating out the existing span and locating it at a facility to allow for rehabilitation prior to reinstallation of the rehabilitated span was studied and set aside in favor of the less risk oriented and more construction time sensitive option to rehabilitate the span in place. Although floating out a span, locating it at a dry dock, and floating it back into place is technically possible, it is preferable to "handle" the existing truss as little as possible to mitigate risk of damage and project delays.

Construction will also be significantly more efficient with the lift span still in place. The contractor can use the lift span to move materials across the river and access the Maine and New Hampshire spans. If the lift span is removed, the contractor will rely on barges, and detour routes to move materials and workers around the project site. A temporary connection would halt navigation traffic. The lift span is anticipated to be in the up position for 2 months during trunnion and sheave replacement, but the contractor would be able to use the lift span after 2 months for access. If the span was floated out for rehabilitation, that would not be possible.

Additional Points of Discussion During the Meeting of May 11:

<u>Painting Costs:</u>

Comparing actual costs at time of future painting (assuming 4% inflation) the new lift span would result in approximately $ 22 million in savings over the 54-year life span. A detailed calculation is provided at the end of this memo

Total Life Span Costs:

It is evident from the table below that a new lift span is significantly more cost effective when considering the life span of the structure. A new lift span would be approximately $22 million more cost effective over a 54-year life span.

The following table adds the current construction cost estimates to the predicted future painting costs over the life span of the structure. Since the costs for maintenance activities for the approach spans would be the same in either alternative, the future painting cost only includes the lift span**:**

Total Life Span Costs: Rehabilitation compared to New Lift Span

	Initial Construction	Future Painting	Total Life Span Cost
Rehabilitation	$37.6	$67.4	$105
New Lift Span	$38.4	$44.9	$83.3

Future Funding and Advancing Deterioration:

The fiscal reality is that full funding for the future painting may not be available. If the painting system is not maintained, the steel will become exposed and deteriorate. On the existing lift span, since many structural steel members have already exhibited deterioration, there is less ability to accept future deterioration. The new span would be comprised of steel without deterioration and would be able to accept some deterioration should a painting system fail to be maintained.

In particular the lower chord members of the lift span have exhibited significant deterioration. If the painting system is not maintained, the lower chord will continue to deteriorate to the level where the bridge will either require load restrictions or closure. The lower chord of the lift span is critical to stability of the truss. Replacement of the lower chord while the bridge is still located in the middle of the river is extremely challenging for construction and operation of the bridge. In order to remove the lower chord of the truss, significant temporary bracing would need to be installed to maintain truss stability during construction. The temporary bracing and removal of the lower chord would change the weight of the lift span, which would require continual rebalancing of the lift span to maintain operation. These construction activities are technically possible, but realistically not feasible.

Painting System and Lift Cycle Costs:

Due to the chloride infiltration, built up members, and difficult access locations, it is expected that paint on a rehabilitated span would last approximately 1/3 less than a shop applied paint system to a new span.

The following example is based on a 54-year life span of the bridge. A span of 54 years was chosen for mathematical simplicity.

Assumptions and Data:

Terms and Definitions

Practical System Life – time at which 5 to 10% of coating breaks down and rusting occurs
Touch Up Painting – spot touch up of failed areas
Maintenance Painting – spot prime and a single full recoating
Full Repaint – total coating removal and replacement

Practical Painting System Life Span

Existing Rehabilitated Span	10 years
New Span	15 years

Painting System Maintenance Activities

Touch Up Painting	at end of Practical Life
Maintenance Painting	Practical Life Year + 33% Practical Life
Full Repaint	Maintenance Paint Year + 50% Practical Life

Painting System Activities	*Touch Up*	*Maintenance*	*Repaint*
Existing Rehabilitated Span	Year 10	Year 13	Year 18
New Span	Year 15	Year 18	Year 27

Painting System Application Costs

Existing Rehabilitated Span	$2.5 million
New Span	$2.25 million

* (New Span cost is 90% of rehab based on easier cleaning and painting activity)

Painting System Maintenance Costs

Touch Up Painting	40 % of Original Cost
Maintenance Painting	70 % of Original Cost
Full Repaint	100% of Original Cost

Painting System Maintenance Costs	*Touch Up*	*Maintenance*	*Repaint*
Existing Rehabilitated Span	$ 1.0 mill	$ 1.75 mill	$ 2.5 mill
New Span	$ 0.9 mill	$ 1.58 mill	$ 2.25 mill

The table below estimates the long-term costs of painting required for the Memorial Bridge based on the above assumptions. The costs are presented in both Present Day Costs and as an Inflated Cost to account for cost for inflation of 4% per year in construction costs and reflect the estimate of actual costs at the future year of construction.

	Rehabilitated Span			**New Shop Constructed Span**		
Year	**Activity**	**Present Day Cost**	**Inflated Cost**	**Activity**	**Present Day Cost**	**Inflated Cost**
0	Original Paint			Original Paint		
10	Touch Up	1	1.48			
13	Maintenance	1.75	2.91			
15				Touch Up	0.9	1.62
18	Repaint	2.5	5.06			
20				Maintenance	1.58	3.45
27				Repaint	2.25	6.49
28	Touch Up	1	3.00			
31	Maintenance	1.75	5.90			
36	Repaint	2.5	10.26			
42				Touch Up	0.9	4.67
46	Touch Up	1	6.07			
47				Maintenance	1.58	9.95
49	Maintenance	1.75	11.96			
54	Repaint	2.5	20.78	Repaint	2.25	18.71
Present Day Cost Totals		**15.75**			**9.5**	
Inflated Cost Totals			**67.4**			**44.9**

All costs are presented in Millions of dollars

Rehabilitation is (15.75 – 9.5 =) $6.25 million more expensive in Present Day Dollars
Rehabilitation is (67.4 – 44.9 =) $22.5 million more expensive in Inflated Dollars

Additional costs and logistics associated with painting the flanking spans will be presented at the June 8 meeting. The additional costs and logistics will consider the overall bridge painting costs and not focus solely on the lift span.

Additional discussions raised at the meeting during or after the presentation are summarized below.

Jim Garvin inquired whether removal of the lift span for rehabilitation overland would allow stresses to be relaxed to permit the repairs to be performed more thoroughly. John Watters indicated that this is technically and physically possible. It was agreed that more discussion of off-site rehabilitation would be provided.

Jim Garvin commented that, in calculations of future maintenance, the lift span comprises a certain percentage of the total bridge, and, even under the lift span replacement, there would still be more frequent repainting of spans 1 and 3. He indicated that this future maintenance of the flanking spans should be factored into consideration.

Harry Kinter commented on the proposed droop cable and inquired whether use of the old system presented an OSHA issue. John Watters indicated that replacement of the system may be grand fathered and that there is a high voltage warning sign on the existing fence, but was unsure of the actual OSHA regulations. He commented that, under proposed conditions, there would be no need to step over the existing trolley system to access the counterweight and knob and tube wiring would be located within the control house.

Bill O'Donnell inquired whether a barge under the lift span (@for which option?) would conflict with navigation. John Watters indicated that coordination would be performed with the U.S. Coast Guard. He stated that there might be a need to occupy the middle of the channel at times, and, if so, the barge would need to move to accommodate navigational traffic.

Jim Garvin inquired whether equipment moves during lifts was factored into the costs, since this is an encumbrance. John Watters indicated that, under the lockout, tag-out procedure during lifts, some material can be left on the lift span if it is secured during construction, and this was factored into the costs. He commented that amended navigational rules, established under a 60-day comment process, provide the contractor flexibility.

Mike Johnson commented that the presentation provided a thorough assessment of replacement with rolled steel compared with rehabilitation or replacement in kind. Harry Kinter commented that the Section 4(f) tests are either prudency or feasibility. Mike Johnson indicated that, in either case, he is looking for a formal statement addressing Section 4(f) feasibility/prudency. Harry Kinter stated that justification for why rehabilitation is not prudent should be provided for review. He indicated that the consultants have provided a lot of information that would form the basis of the 4(f) argument. Mike Johnson commented that prudency should address new steel with in kind costs. Nancy Mayville stated that the presentation forms the basis for the Section 4(f) Evaluation.

Jim Garvin stated that the thought process for preserving the lift span, under which adverse effects would be avoided, needs to be addressed, because the rehabilitation off site had been dismissed. Cost figures should address maintenance of spans 1 and 3 (flanking spans) over 50 years (e.g. for 54 years) as well as the cost of maintenance of the built-up fabric for the lift span versus the replacement span. The different maintenance costs between replacement, rehabilitation in place, and rehabilitation off-site should be addressed in the 4(f) prudency discussion with the same rigor. Rehabilitation off site would allow the replacement of the lower chords, which are so fracture critical, in the lift span. This evaluation should include use of the dry dock of the Naval Shipyard or New Hampshire State Pier. Jim Garvin inquired how much more it would cost to remove the lift span and perform this thorough rehabilitation. He stated that the cheese-plate type repairs performed were not reassuring. He stated that clearly, this alternative should be considered if costs permitted rehabilitating the structure to the same degree of longevity.

John Watters inquired who had political authority over the State Pier and the naval shipyard.

Jim Garvin stated that an evaluation of removing the lift span, bringing it off site, shoring it up with a new lower chord and panel points, while saving the top part should be evaluated to answer preservation concerns. Why this is not prudent should be laid out. Nancy Mayville stated that costs would be attributed to this alternative.

Joyce McKay inquired whether it would be helpful to look at rehabilitation in other states. Jim Garvin stated that he knows this can be done. John Watters stated that HNTB is working on a New York 70-foot wide swing span bridge that is being fabricated in Albany, NY, and will be floated down the Hudson River in November. Another project was fabricated in Alabama and floated to New York City. Joyce McKay indicated that this would be another point of comparison.

Jim Garvin stated that he had approved other bridge projects where the lower portion of the bridge was cut off to preserve the upper portion.

Richard Candee mentioned that the Hanalei Bridge in Hawaii was a warren truss that was modified and held together by a supplemental truss. Dave Hall inquired about conditions to reconnect the diagonals and verticals to the new chord. John Watters indicated that there has been section loss on these members, but they could most likely be cut and spliced at locations where sufficient material still exists.

Jim Garvin indicated that this would involve welding steel to the existing angles. John Watters responded that welding could be accomplished, but it would most likely involve bolting since there would be fatigue concerns associated with welding.

Dave Hall asked, if the structure was built off site, where this would be performed. He commented that if there are additional moves of the structure, there is not time under the compressed construction duration to accomplish this. He commented that removing the structure twice would be half again as costly. John Watters indicated that this would be looked at sufficiently to provide an estimate (perhaps as cost per pound or per square foot). Harry Kinter stated that enough information on cost should be formulated to dismiss this option. John Watters indicated that this would be estimated plus or minus $1 million. He mentioned several projects where bridges were constructed off site from remote locations (from Tampa, Florida to Alabama to Albany, etc.). Richard Candee concurred that ballpark numbers for off-site manufacturing would suffice.

Nancy Mayville suggested that one more meeting to respond to issues raised should be held. Kevin Nyhan and Harry Kinter indicated that materials to support Section 4(f) determinations should be presented in a few weeks. Nancy Mayville commented that the NHDOT is under direction to complete the final design by November 2007, which leaves 18 months if a design contract is put in place this summer, and staff are working to put funding together for the project.

Joyce McKay concluded the meeting and noted that the next cultural resource meeting to discuss the Memorial Bridge Rehabilitation would be held on June 1, 2006.

Submitted by Joyce McKay, Cultural Resources Manager

c.c.	J. Brillhart	K. Cota	N. Mayville	Bill Cass
	C. Barleon, OSP	C. Waszczuk	D. Lyford	
	V. Chase	R. Roach, ACOE	H. Kinter, FHWA	

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